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A Comparison of the Mortality Rate After Elective Repair of Aortic Aneurysms Detected Either by Screening or Incidentally

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Objective: to compare predicted and actual mortality rates, using POSSUM scoring, after elective repair of abdominal aortic aneurysms (AAAs) detected from the Gloucestershire Aneurysm Screening Programme and those discovered incidentally.

Methods: a sample of 276 men undergoing elective AAA repair in Gloucestershire between 1991 and 1998 was studied. AAAs were either detected from the screening programme or were discovered incidentally and referred from other sources. Mortality data relating to these patients have been recorded prospectively. POSSUM scoring was performed retrospectively from patients' notes in both groups and related to outcome (30 day and in-hospital mortality). POSSUM and P-POSSUM methodology were used to compare observed and predicted mortality rates.

Results: in the 276 men who had elective AAA repair, the overall mortality rate was 7%. Mortality was lower in screen-detected AAAs (3/111, 3%) than AAAs discovered incidentally (16/175, 9%) ($p=0.05$). Preoperative physiology scores were significantly lower in men with a screen-detected AAA (median 19, range 13–29 versus 21, 12–41, $p<0.001$). POSSUM operative scores were similar between the groups. Actual versus predicted death ratios in the sample group were more accurate using POSSUM (ratio 0.93) than P-POSSUM (2.38) analysis.

Conclusions: men with a screen-detected AAA had a lower mortality rate after elective repair than in those detected incidentally; lower preoperative physiology scores suggested they were fitter (as well as younger). In this study POSSUM analysis more accurately predicted outcome than P-POSSUM.

Key Words: aortic aneurysm; screening; postoperative complications.

Introduction

There are approximately 6000 deaths per annum from abdominal aortic aneurysm (AAA) in England and Wales.¹ The overall mortality if an AAA ruptures ranges from 80–90%.^{2,3} Only 40% of patients with a ruptured AAA survive to reach hospital and fewer than 50% of these have a successful aneurysm repair. This contrasts with reported mortality from elective aortic aneurysm surgery of less than 5% in many series,^{4,5} though population studies have suggested that the actual death rate may be nearer 10 per cent.^{6,7}

The aim of aortic aneurysm screening is to reduce the overall community mortality by identifying patients with an AAA and then performing elective repair. An AAA screening programme started in Gloucestershire in 1990.⁸ The results of elective AAA surgery depend partly on the health of the patients

undergoing surgery. It is not known how the general health of men with an AAA detected by screening compares with those in whom an AAA is detected incidentally. This study compared the outcome of elective repair in both groups of patients.

Crude mortality rates after AAA repair give an indication of comparative outcome but do not take account variations in the fitness of the patients. POSSUM⁹ and P-POSSUM¹⁰ scoring systems have been used to compare surgical outcomes in different populations by accounting for case-mix and have been validated in vascular surgical patients.^{11–13} The aim of the present study was to use POSSUM methodology to compare observed and predicted mortality rates in a large sample of men having repair of an AAA detected either by screening or incidentally.

Methods

Men who had an elective AAA repair in Gloucestershire between 1991–1998 inclusive were studied.

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Patients undergoing emergency or urgent repair of a non-ruptured AAA (defined as non-routine admission or operation out of hours) were excluded. Some aneurysms were detected incidentally and referred to the vascular surgical service either by their general practitioners or other hospital consultants; the remainder were identified from the local aneurysm screening programme. Women were excluded as they are not examined as part of the screening programme.

POSSUM and P-POSSUM scoring

The aim was to sample the case notes of at least 250 men who had an AAA repair in the two groups: screen-detected and incidentally detected. All notes from 1991–1998 of patients who had elective AAA repair were requested from medical records and processed as they were retrieved until the sample size was achieved. The notes were reviewed retrospectively and used as a data source for POSSUM scoring. Scoring was done by the authors and specialist registrars acknowledged at the end of the paper. POSSUM scores were derived from 12 physiological data items scored preoperatively and six operative data items. Physiological and operative scores were derived according to the method of Copeland *et al.*⁹ Predicted mortality from POSSUM data was generated from a curvilinear equation and from P-POSSUM in a linear manner after Whiteley *et al.*¹⁰ Mortality was defined as death within 30 days or the same hospital admission. Observed versus expected mortality graphs were generated for

aneurysms detected by screening and for those identified as an incidental finding.

Gloucestershire Aneurysm Screening Programme⁸

The programme commenced in 1990 and is based in general practitioner surgeries. The target population is men reaching 65 years of age. Since 1990, 24 479 invitations for screening have been mailed and 20 633 ultrasound scans performed, a compliance rate of 84%. By the end of 1998, birth years 1925–1933 inclusive have been offered screening, and 446 aortas over 4.0 cm diameter have been detected.¹⁴ A total of 184 elective aortic repairs have been performed on patients from the screening programme, 177 in Gloucestershire and seven in hospitals in the adjacent counties. The County of Gloucestershire is served by two district general hospitals. Each has two specialist vascular surgeons; all perform elective aortic surgery. All operations were performed or directly supervised by one of the consultants. During the study the criteria for operation and exclusion were similar for all patients in both groups. The main indication was size of the aneurysm which ranged from 5 cm to 5.5 cm (after the Small Aneurysm Trial results).¹⁵

Results

Mortality after elective aneurysm repair

Of the 411 men who had elective AAA repair in Gloucestershire between 1991–1998, retrospective

Table 1. Results of POSSUM and P-POSSUM scoring in 276 men undergoing elective AAA surgery.

POSSUM Risk of death	No. of ops.	Mean risk %	Predicted deaths	Observed deaths	O:E
0–4%	67	3.1	2	5	2.5
4–10%	164	6.3	10	8	0.8
10–25%	40	15.1	6	5	0.8
25–60%	5	38.5	2	1	0.5
0–100%	276	11.4	20	19	0.93
(O:E) = Observed vs expected ratio.					
P-POSSUM Risk of death	No. of ops.	Mean risk %	Predicted deaths	Observed deaths	O:E
0–%	232	1.6	4	13	3.25
4–10%	34	6.6	2	4	2
10–25%	7	15.2	1	1	1
25–60%	3	41.5	1	1	1
0–100%	276	2.9	8	19	2.38

(O:E) = Observed vs expected ratio.

Table 2(a), (b). POSSUM and P-POSSUM scoring in patients undergoing elective AAA repair.

(a) Screen-detected AAA's					
POSSUM					
Risk of death	No. of operations	Mean risk (%)	Predicted deaths	Reported deaths	O:E ratio
0–4%	31	3.2	1	1	1
4–10%	73	6.0	4	1	0.3
10–25%	7	14.4	1	1	1
P-POSSUM					
Risk of death	No. of operations	Mean risk (%)	Predicted deaths	Reported deaths	O:E ratio
0–4%	104	1.5	2	2	1
4–10%	7	6.7	0	1	–
(b) AAA's detected incidentally					
POSSUM					
Risk of death	No. of operations	Mean risk (%)	Predicted deaths	Reported deaths	O:E ratio
0–4%	36	3.1	1	4	4
4–10%	91	6.5	6	7	1.2
10–25%	33	15.2	5	4	0.8
25–60%	5	38.5	2	1	0.5
P-POSSUM					
Risk of death	No. of operations	Mean risk (%)	Predicted deaths	Reported deaths	O:E ratio
0–4%	128	1.7	2	11	5.5
4–10%	27	6.6	2	3	1.5
10–25%	7	15.2	1	1	1
25–60%	3	41.5	1	1	1

POSSUM scoring was achieved in a sample of 276 (67%); 111 patients with screen-detected and 165 with an AAA discovered incidentally. The median age of all the men who had POSSUM scoring was 70 years (range 51–94). As a result of the screening programme methodology men with a screen-detected AAA were significantly younger (median age 66 years, range 65–71) than the non-screened group (median age 73 years, range 51–94), (Mann–Whitney U-test, $U=10.5$, $p<0.001$). The mortality rate in the patients who had POSSUM scoring was 19/276 AAA repairs (7%). The mortality rate was significantly lower in men who had an aneurysm detected by screening (3/111, 3%) than those detected incidentally (16/175, 10%), ($\chi^2=4.5$, $p=0.05$).

Mortality in the entire series of 411 men who had elective aneurysm repair was similar to that in the selected sample (27/411, 7%, $\chi^2=0.02$, n.s.).

POSSUM scoring

The results of POSSUM and P-POSSUM scoring for men who had elective AAA in the two study groups are shown in Table 1. The table demonstrates stratification of risk of mortality and allows comparison of observed versus predicted deaths. If either POSSUM scoring method accurately predicts outcome, the observed: predicted ratio should approach unity. The overall observed: predicted ratio using POSSUM scores was good at 0.93. The ratio using P-POSSUM methodology was not as good, 2.38, the majority of the excess deaths were in the low risk bands. P-POSSUM methodology placed the majority of the men in the study in the 0–4% risk band, whereas POSSUM spread the men more evenly through the risk bands.

The results of the POSSUM and P-POSSUM analysis separated into screen-detected and incidentally

discovered AAAs are shown in Table 2. The patterns are similar to the overall results, though men with incidental aneurysms tended to be in higher risk bands.

Median POSSUM preoperative physiology scores were significantly lower in men with screen-detected AAAs (19, range 13–29) than those discovered incidentally (21, 12–41), ($F=13.7$, $p<0.001$ t -test for equality of means). The operative scores were similar in both groups: 11 (8–14) versus 11 (6–15), respectively ($p=n.s.$). Apart from age, as detailed above, the other main physiological score that was higher for men with an incidentally discovered AAA was ECG signs in the 61–70 year age group (mean score 4.29 versus 2.98).

Discussion

One anxiety about aortic aneurysm screening was that it would simply discover unhealthy men with severe cardiorespiratory morbidity who were identified by the fact that they had an AAA. The present study shows that the Gloucestershire programme detected men with AAAs who were fitter than the men who had an AAA discovered incidentally, as evidenced by their lower preoperative POSSUM physiology scores. Although the younger age of the screened patients accounts for some, it cannot account for all the difference in the preoperative physiology scores. In addition the mortality rate was lower after elective repair of screen-detected than incidentally discovered AAAs (3 versus 9%). The high mortality rate of 9% in the incidentally detected group may simply reflect the fact that a significant proportion of the lower risk patients in this community were identified by screening. The overall mortality rate of 7% was a little higher than the rate of 5.8% in the U.K. Small Aneurysm Trial,¹⁵ but was lower than in population studies^{6,7} and is probably representative of a routine vascular practice.

Ideally, POSSUM scoring should have been done on all 411 patients. The selected sample of 276 patients may have been unrepresentative, particularly if case notes in complicated cases were difficult to retrieve. However, the sample size included two thirds of elective AAA operations in men and a similar proportion of all deaths. The mortality rate in the sample group was similar to that in the whole population, although only three deaths occurred in the screened group who had POSSUM scoring. Any differences in the populations should have been accounted for by the case-mix analysis using POSSUM. Another possible confounding factor is that surgeons might have been more careful over operations on screened patients, though there is no evidence for this. As the study was

retrospective, we only included the hard end-point of death and excluded complications.

POSSUM scoring is becoming an accepted method of case-mix analysis, particularly in vascular surgical patients.^{11,12} Several methods of analysing POSSUM scores are currently under evaluation. In the present study, the original POSSUM methodology was more predictive of outcome (observed: predicted ratio 0.93). P-POSSUM methodology underpredicted the number of deaths (observed: predicted ratio 2.38), principally because the majority of AAA repairs were allotted to the 0–4% risk category. Others have done similar analyses; Midwinter *et al.* found P-POSSUM to be the better predictor of outcome.¹² Larger studies, such as the one completed by the Vascular Surgical Society of Great Britain and Ireland, should gather enough information to permit conclusions about the ideal method of analysis.¹³ POSSUM scoring is able to predict outcome across a wide range of conditions in general surgery¹⁰ but it may be necessary to refine the methodology when evaluating a single condition. Recently it has been shown that the preoperative physiology score alone predicts both morbidity and mortality.¹³ This fits with findings from the present study where the operative scores were similar in both groups and therefore had no effect on outcome prediction. An alternative explanation of the result of this study is that P-POSSUM is predicting correctly, but that there were more deaths than should be expected in Gloucestershire. There did appear to be an excess of deaths in the low risk categories, though the crude mortality rate was similar to the Small Aneurysm Trial results.¹⁵

In conclusion, the present study has shown that men identified from the Gloucestershire Aneurysm Screening Project had a lower mortality rate after elective AAA repair than men whose AAA was discovered incidentally. They were generally fitter, as evidenced by lower preoperative POSSUM physiology scores, partly accounted for by their younger age and partly by fewer signs of cardiac disease on ECG. POSSUM scoring more accurately predicted outcome than P-POSSUM in the present investigation. The study provides further evidence of the benefit of community aneurysm screening in men.¹⁴

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